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A statistical analysis of individual success after successful completion of Defense Language Institute Foreign Language Center Training

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THESIS

A STATISTICAL ANALYSIS OF INDIVIDUAL SUCCESS AFTER SUCCESSFUL COMPLETION OF DEFENSE LANGUAGE INSTITUTE FOREIGN LANGUAGE CENTER TRAINING

by

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September 2005

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The Defense Language Institute Foreign Language Center (DLIFLC) trains students in various foreign languages and dialects for the Department of Defense (DOD). The majority of students are first-term enlistees in the basic program. This study uses classification trees and logistic regression to understand the military, academic and personal characteristics that influence first-term success after successfully completing DLIFLC training. Success was defined as completing a first-term enlistment contract and maintenance of language proficiency. DLIFLC management was interested in the difference in success for individuals that graduated DLIFLC via the different training pipelines. Students graduate by completing the program as originally assigned, or by recycling, relanguaging or taking DLPT enhancement training multiple times and in multiple combinations due to various academic, administrative or other reasons. 63% of students graduated. Only 45% of those that graduated were successful post-DLIFLC. Results identified several factors influential in predicting success; the factors were service affiliation, contract lengths and gender. Training pipelines were slightly influential. Individuals in the Army had the worst odds of success. Contract lengths greater than four years had lower odds of success. Males had higher odds of success than females.

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A STATISTICAL ANALYSIS OF INDIVIDUAL SUCCESS AFTER SUCCESSFUL DEFENSE LANGUAGE INSTITUTE FOREIGN LANGUAGE CENTER TRAINING

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ABSTRACT

The Defense Language Institute Foreign Language Center (DLIFLC) trains students in various foreign languages and dialects for the Department of Defense (DOD). The majority of students are first-term enlistees in the basic program. This study uses classification trees and logistic regression to understand the military, academic and personal characteristics that influence first-term success after successfully completing DLIFLC training. Success was defined as completing a first-term enlistment contract and maintenance of language proficiency. DLIFLC management was interested in the difference in success for individuals that graduated DLIFLC via the different training pipelines. Students graduate by completing the program as originally assigned, or by recycling, relanguaging or taking DLPT enhancement training multiple times and in multiple combinations due to various academic, administrative or other reasons. 63% of students graduated. Only 45% of those that graduated were successful post-DLIFLC. Results identified several factors influential in predicting success; the factors were service affiliation, contract lengths and gender. Training pipelines were slightly influential. Individuals in the Army had the worst odds of success. Contract lengths greater than four years had lower odds of success. Males had higher odds of success than females.

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EXECUTIVE SUMMARY

The Defense Language Institute Foreign Language Center (DLIFLC) at the United States Army Presidio of Monterey, California trains over 3,000 personnel in 23 languages and several dialects annually. Personnel include officers and enlisted members of all branches of the armed services, as well as personnel from several civilian agencies and international students. The majority of personnel who enter the DLIFLC are first-term enlistees with less than two years of service and enroll into the basic course of instruction. While trying to successfully complete DLIFLC, a student may complete the program as originally assigned, recycle into the same language in a later class, relanguage into a different language (usually a language of lesser difficulty), drop from the program or require Defense Language Proficiency Test (DLPT) enhancement training. There are a number of reasons (academic, medical, other, etc.) classified by DLIFLC that affect a student's ability to complete the program as originally assigned. This study is interested in the military, academic and personal factors that influence post-DLIFLC success of first-term enlistees from the basic course of instruction who entered DLIFLC during fiscal years 1997 – 2000 and graduated.

To have been considered a graduate of the DLIFLC, an individual had to successfully complete his or her course of instruction and meet the requirements of the Defense Language Proficiency Test (DLPT). There are numerous training pipelines that a student could traverse in order to graduate. Training pipelines were based on whether a student graduated the program as originally assigned,

recycled, relanguaged or required DLPT enhancement training. Each of these steps could be repeated multiple times and in multiple combinations. Each distinct path was considered a new training pipeline. There were 56 pipelines established in the data gathered. These pipelines were collapsed into 8 pipelines in which meaningful analysis could be accomplished. This study was particularly interested in the influence of these pipelines on post-DLIFLC success.

Post-DLIFLC success was defined as an individual completing his or her contractual enlistment obligation and maintaining his or her language proficiency. Individuals were considered to have completed their enlistment contract if they did not leave the service up to three months prior to the end of the contract. Maintenance of language proficiency was determined by the receiving of Foreign Language Proficiency Pay (FLPP) up to six months prior to leaving the service. An individual was considered a success if both of these conditions were met.

Descriptive statistics were first calculated to better understand the data population. Only 63% of the students this study was concerned with graduated the DLIFLC. Out of those individuals who graduated the DLIFLC only 45% were subsequently successful. This data was broken down further and statistical significance determined for success rates among different training pipelines, service, gender and contract lengths. Inferential statistics showed that there were statistically significant differences between services, gender, AFQT scores and contract lengths. The statistics showed that there is some interaction between service and contract length. In addition, it was

discovered that the majority of observations for AFQT scores below 75 were missing AFQT data. Because of this fact, no meaning can be attributed to the findings concerning AFQT scores.

The classification tree method was used to better understand the influence of all the independent variables looked at in this study. A classification tree was grown, cross-validated and pruned to produce a tree that did an adequate job of classifying observations. The tree also provided useful information about how to build the numeric independent variables into useful categorical variables.

Finally, logistic regression was used to further analyze the influence of all independent variables. After assessing the "goodness-of-fit" and adequacy of the different models produced, a final model was decided upon. This model provided further insight into which factors were most important in influencing post-DLIFLC success.

This study found that training pipeline, service affiliation, contract lengths, citizenship, gender and AFQT scores were all common factors in predicting success. Though training pipelines had some minor influence, they were not as distinguishable as the other factors. Contract lengths were very influential in determining success. Individuals who had contract lengths of greater than four years were 0.08-0.56 as likely to succeed as individuals who had contracts of four years or fewer. In terms of service affiliation, being in the Army had the most negative impact on success while the Air Force had the most positive effect, followed by the Marine Corps. Service affiliation is noteworthy in that the majority of students that pass through DLIFLC are in the Army or Air Force.

Males were more likely to be successful than females. Males had 1.38 times greater odds of success than females. Though AFQT scores were found to be significant in explaining success, because of the fact that the majority of observations below the score of 75 were missing AFQT data, no conclusions can be drawn from the analysis of AFQT. The variable AFQT was left in the model because the model had better “goodness-of-fit” with the variable than without it.

INTRODUCTION

The Defense Language Institute Foreign Language Center (DLIFLC) at the United States Army Presidio of Monterey, California trains over 3,000 personnel in 23 languages and several dialects annually. While trying to successfully complete training at the DLIFLC, a student may complete the program as originally assigned, recycle into the same language in a later class, relanguage into a different language (usually a language of lesser difficulty), drop from the program or require additional training after having taken the end-of-program Defense Language Proficiency Test (DLPT). There are a number of reasons classified by DLIFLC (academic, medical, other, etc.) that document a student's progression through the program assigned. The paths through the DLIFLC based on reason classifications are considered training pipelines for this study.

This study analyzes the various training pipelines through the DLIFLC and other military, academic and personal characteristics to determine their effects on post-DLIFLC success of first-term enlistees. Success is defined as completion of initial enlistment contract obligation and maintenance of foreign language proficiency. Models are developed using regression classification trees and logistic regression techniques to better understand the factors that are related to post-DLIFLC success and to be able to adequately predict success. This information will assist the DLIFLC in beginning to address the issue of return on investment for each of the training pipelines. Additionally, it will allow the individual services to

identify and intervene for those service members who are at greater risk for attrition and/or loss of linguistic proficiency.

A. BACKGROUND

1. Mission of DLIFLC

The mission of the DLIFLC is to educate, sustain, evaluate and support foreign language specialists under guidelines of the Defense Foreign Language Program. The DLIFLC trains over 3,000 officer and enlisted members from the Army, Navy, Air Force and Marine Corps and select civilian and international personnel annually. Instruction is provided in 23 languages and several dialects through 31 language departments and the Emerging Languages Task Force (ELTF). (www.dliflc.edu) All of these languages and dialects are subdivided into four difficulty categories. The categories are numbered from I to IV with IV being the most difficult languages to learn for English speakers. Each category is associated with a corresponding length of study for initial basic language training. Category I requires 25 weeks, Category II 34 weeks, Category III 47 weeks and Category IV 63 weeks. Category IV languages include Arabic, Chinese, Korean and Japanese.

The DLIFLC provides training at the basic, intermediate, advanced and specialized levels. The majority of students are enlisted and take the basic program of study during their first-term of enlistment.

2. DLIFLIC Pre-Qualifications

In order to qualify for language study, a student must successfully pass the Defense Language Aptitude Battery (DLAB). Prerequisites include a minimum score of 85 for Category I, 90 for Category II, 95 for Category III and 100 for Category IV languages. Though these are minimum requirements, there are exceptions to these rules. There are various reasons for these exceptions (native speaker, service requirements, etc.).

3. Successful Completion of DLIFLC

When students arrive at the DLIFLC they are assigned a program of study with the number of weeks of training corresponding to the category of their language. In order to successfully complete the DLIFLC program, a student must complete the program of study with at least the minimum grade point average. After completion of the course of study, the student must then take and pass the DLPT. The DLPT is divided into three sections consisting of listening, reading and speaking. The proficiency standards tested by the DLPT are based on the Interagency Language Roundtable (ILR) proficiency level descriptions. (www.govtilr.org) Descriptions of these standards are provided in Table 1.1.

A student must meet the requirement of 2/2/1+ on the DLPT. This requirement indicates a proficiency of level 2 in listening and reading and a 1+ in speaking. A “+” indicates a proficiency above the base standard, but not at the next level.

Table 1.1 Interagency Language Roundtable Proficiency Standards

Level	Function/Tasks	Context	Accuracy
3	Support Opinions Hypothesize Explain Deal with Unfamiliar Topics	Practical Abstract Special Interests	Errors never interfere with communication and rarely disturb the native speaker
2	Narrate Describe Give Directions	Concrete Real-World Factual	Intelligible even if not used to dealing with non-native speaker
1	Q and A Create with the Language	Everyday Survival	Intelligible with effort and practice
0	Memorized	Random	Unintelligible

DLIFLC Command Briefing Slides (Anderson, 1997)

Using data from the DLIFLC for fiscal years 1990-present, the average rate for successful completion for all enlisted personnel in the basic course was 56%. Figure 1.1 illustrates the successful completion rates from 1990-present. Figure 1.1 shows that there was a significant increase in completion rates between 1990–present. Rates increased from 43% to 63% over this time period. The reason for the increase in completion rates is unknown. The data for this study included individuals who entered from 1997–2000. This period corresponds to the sharpest increase in completion rates.

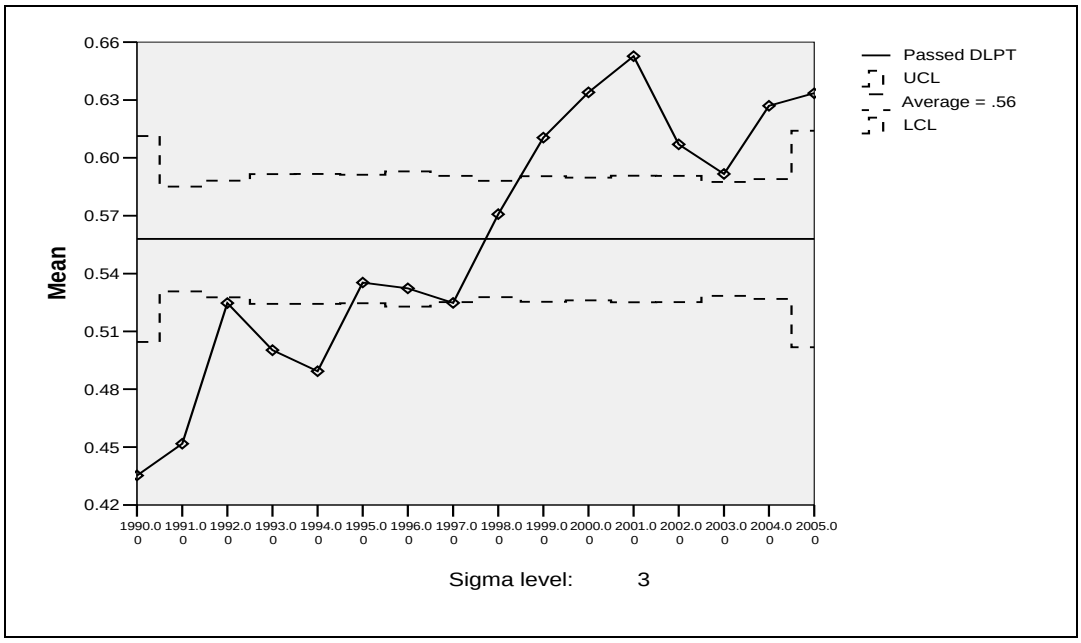

Figure 1.1 Successful Completion Rates 1990-Present

Compiled from data from DLIFLC. Confidence Intervals are for the overall average of 56%, but are not relevant.

4. DLIFLC Training Pipelines

Based on data gathered from the DLIFLC from 1990-present only 45% of enlisted personnel in the basic program successfully completed DLIFLC in the originally allotted time. The remaining 11% of students who successfully completed the DLIFLC program did so through various means. Some students recycled into a later class of the same language. There are a number of students who relanguaged into a different language (normally a lower category language) in a later class. There are a few students who required DLPT enhancement training after completing their program of study and failing to meet the minimum requirements on the DLPT the first time. Students can recycle, relanguage or take DLPT enhancement training multiple times and in numerous combinations. Each of the

routes that lead to successful completion of the DLIFLC is considered a distinct training pipeline for this study.

5. Defining Post-DLIFLC Success

Most students who enter the DLIFLC basic program are junior enlisted personnel serving their first term of enlistment. Normally they have just completed recruit training and most have not completed any type of technical training. In addition, they have not been to their first operational unit. This study will look at the success or failure of junior enlisted (E-4 and below) personnel, who entered the DLIFLC between fiscal years 1997-2000 and successfully completed training and who are serving their first term of enlistment.

Success for these individuals is defined as completing their first term of enlistment and maintaining their language proficiency. An individual will be deemed to have met his or her first term obligation if he or she was not a loss prior to three months to the end of his or her obligation (based on their enlistment contract). This is due to the fact that services routinely use this time as a force-shaping tool, especially near the end of the fiscal year. Maintenance of language proficiency will be determined by whether or not an individual received Foreign Language Proficiency Pay (FLPP) at least six months prior to the end of his or her first term obligation. Six months was used due to the fact that an individual must take the DLPT each year to continue to receive FLPP. We assume that many of the individuals who have already decided to leave at the end of their obligation may not believe the extra

pay for six months or less is worth the time and effort to pass the DLPT. Up to the six-month point it is assumed that the extra pay is enough of an incentive to continue to study for and pass the DLPT (FLPP pay at the maximum $200 per month for an E-3 is approximately 15% of pay after taxes).

B. THE PROBLEM

Previous studies conducted at the DLIFLC have concentrated on attrition at the DLIFLC. To date there have been no studies that have linked an individual's performance at the DLIFLC and his or her success after leaving the DLIFLC. This study tries to bridge that gap and provide valuable information to both the DLIFLC and the individual services.

Students who do not successfully complete DLIFLC as originally assigned are costly to the organization and to individual services. The DLIFLC budgets for a certain number of students in each language for each fiscal year. When students are not able to complete this training as assigned, they are either dropped from the program or are assigned another training pipeline that may not have been properly budgeted for. The DLIFLC is not reimbursed for such expense. In addition, the services lose valuable time and resources when individuals do not graduate on time. Most have to have follow-on schools rescheduled causing further delay in reporting to their first operational unit where the service first sees a return on the large investment in this individual. This study will attempt to identify if there is a difference in the post-DLIFLC

success rates (as defined above) among the various training pipelines at the DLIFLC and other military, academic and personal factors. Identifying factors influential on success and developing an accurate prediction model will enable the DLIFLC to begin to address the return on investment for each pipeline and allow the services to identify those individuals who are at higher risk for attrition and/or not maintaining their language proficiency.

Using data from the DLIFLC and the Defense Manpower Data Center (DMDC) in Seaside, CA, this study looks at junior enlisted personnel in their first term of enlistment who entered the DLIFLC in fiscal years 1997-2000 and successfully completed DLIFLC training. Training pipelines are defined and post-DLIFLC success is established. Inferential statistics will be developed to determine if there is a significant difference in post-DLIFLC success rates among training pipelines and other factors. The training pipeline and other variables deemed important and/or identified in previous studies as important in service attrition are considered in classification trees and logistic regression analysis to develop a prediction model.

C. ORGANIZATION OF THESIS

This thesis is organized into five chapters. Chapter II consists of reviews of literature concerning attrition studies conducted at the DLIFLC and within the individual services. Chapter III describes the data being used and the descriptive statistics developed. Chapter IV is a

description of the methodology, analysis and results. Chapter V contains the conclusions and recommendations for further research.

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II. LITERATURE REVIEW

Most research conducted previously at the DLIFLC has looked at the factors that influence attrition while at the DLIFLC. These studies do not provide any support for this study except to demonstrate the link between performance on the DLAB and success at the DLIFLC.

Attrition studies employed by the services provide some information in terms of the factors that have been proven to be significant in first-term service attrition. These factors will be important to this study.

A. LANGUAGE SKILL CHANGE PROJECT

The Language Skill Change Project (LSCP) was a study conducted by the DLIFLC Research and Analysis Division and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). This was a longitudinal study begun in 1987 that tracked a number of Army students through DLIFLC training and the individual's initial tour of duty. There were various objectives to this study; the objective important to this study was in identifying predictors of success for language learning at DLIFLC.

1. The Prediction of Language Learning Success at DLIFLC

LSCP Report II, "The Prediction of Language Learning Success at DLIFLC," analyzes factors that are related to success at the DLIFLC. Success is defined as completing the course of study satisfactorily and meeting the minimum

requirements on the DLPT. The study found a number of factors that were important in predicting success. Most important to the present study is that language aptitude, as measured by the DLAB, was a significant factor in predicting success. (O'Mara, et al., 1990)

2. Training Approaches for Reducing Student Attrition from Foreign Language Training

LSCP Report III, "Training Approaches for Reducing Student Attrition from Foreign Language Training," analyzed potentially modifiable factors in addressing academic attrition. This study confirmed LSCP Report II's conclusion that the DLAB was a significant factor in predicting success at DLIFLC. A DLAB score of 100 appeared to be a critical value in determining success. (O'Mara, et al., 1994)

B. OTHER DLIFLC ATTRITION STUDIES

There have been a number of other studies concerning DLIFLC attrition. Two Naval Post Graduate School (NPS) students separately conducted thesis research on this subject. Robert E. Anderson carried out research in 1997 entitled, "Study of Initial Entry Student Attrition from Defense Language Institute Foreign Language Center." This study looked at data from fiscal years 1994-1996 and analyzed factors relating to success at the DLIFLC. A binary tree classification method was used to identify the best set of predictors. As with the LSCP Report II & III, this study found that the DLAB was a significant predictor

of success. (Anderson, 1997) Additionally, Chin Han Wong performed a study in 2004 called, “An Analysis of Factors Predicting Graduation of Students at Defense Language Institute Foreign Language Center.” Wong used logistic regression techniques to examine factors affecting success at DLIFLC. His research confirmed all other studies that the DLAB is a reliable predictor of success at DLIFLC. (Wong, 2004)

C. SERVICE ATTRITION STUDIES

Since the inception of the all-volunteer force, the military has been concerned with first-term attrition. Attrition has traditionally been defined as not completing contractual obligation of enlistment. Over the last three and a half decades attrition has hovered around 30%. This number has fluctuated to as high as 40%, but is normally very close to 30%. This attrition implies a huge cost to the military. Recruiting and training are very expensive; it is in the services’ best interests to be able to accurately predict attrition in order to modify recruiting techniques and to identify and intervene for individuals with higher risk of attrition. To this end, there has been a large volume of research connected with military attrition. This is important in that this research identifies factors that might be important in predicting post-DLIFLC success in the present study.

1. Determining Characteristic Groups to Predict Army Attrition

"Determining Characteristic Groups to Predict Army Attrition" was a study conducted in 1999 to identify factors that would aid in predicting attrition for the Army. The Army's Enlisted Loss Inventory Model (ELIM) had not been considered satisfactory; this caused the Office of the Deputy Chief of Staff, Personnel (ODCSPER) to consider other alternatives to the ELIM. The study used Classification and Regression Tree techniques to analyze the factors predicting attrition and develop improved c-groups. The new c-groups were able to outperform the old in terms of misclassification rates. This study found that gender was the most important factor. Other variables that were found important were race, length of service obligation, Armed Forces Qualification Test (AFQT) scores and level of education. (Buttrey and Larson, 1999)

2. Analysis of Early Military Attrition Behavior

"Analysis of Early Military Attrition Behavior" was a study conducted in 1984 by RAND. This study sought to incorporate both military personnel record data and data from the 1979 Survey of Personnel Entering Military Service. This study revealed that high school graduation status, age and pre-enlistment work history were all significant factors in predicting early attrition. In particular, non-high school graduation was the single best predictor for early attrition. (Buddin, 1984)

3. What Characterizes Successful Enlistees in the All-Volunteer Force: A Study of Male Recruits in the Navy

"What Characterizes Successful Enlistees in the All-Volunteer Force: A Study of Male Recruits in the Navy" was a study conducted in 1992 to ascertain the factors that affect attrition among male service members in the Navy. An analysis using logistic regression techniques was utilized to determine the factors that were important in influencing attrition. This study found that high school graduation status, Delayed Entry Program (DEP) time, race and AFQT scores were all important factors. (Cooke & Quester, 1992)

D. SUMMARY

Though there have been no studies that have linked the DLIFLC experience and post-DLIFLC success, there has been a great deal of research on DLIFLC attrition and service attrition that has provided valuable insight into factors affecting attrition. Attrition studies at the DLIFLC have convincingly shown that the DLAB is a significant factor in determining DLIFLC success. Though other factors considered were also found to be important predictors, the DLAB is critical in that it can be assumed to be a reliable cognitive screen for language aptitude. Service attrition studies have yielded factors that are consistent in predicting attrition. The factors gender, age, race, length of service contract, education

level and AFQT scores were all significant predictors of attrition and are important in beginning to understand post-DLIFLC success.

III. DATA AND DESCRIPTIVE STATISTICS

A. DATA

The DLIFLC maintains a database of student information dating back to 1990. There are over 50,000 entries in this database. The data contain various personal and professional statistics on each student (SSN, Date of Birth, Language, Start Date, DLPT scores, etc.). The DMDC maintains multiple databases on all Armed Forces personnel. These databases contain personal and professional statistics on each service member (SSN, Date of Birth, Term of Service, Total Active Federal Military Service, Foreign Language Proficiency Pay, etc.). The data for this study was obtained from the DLIFLC and then merged with data from the DMDC corresponding to each individual.

1. DLIFLC Data

The majority of training at the DLIFLC involves first-term enlistees (less than 1-2 years of service/E-4 and below) who are enrolled in the basic program of instruction in the foreign language to which they have been assigned. This study was concerned with individuals who began instruction during fiscal years 1997-2000.

The data obtained from the DLIFLC contained all entries for the basic course of study since 1990. It should be noted that a student could have multiple entries in the database due to recycling, relanguaging and DLPT-enhancement training. Once the data was sorted for entry date and for junior enlisted (E-4 and below) status and

multiple entries collapsed to a single entry there were 6,162 distinct observations. These observations were then sorted based on successful completion of DLIFLC training. This yielded 3,868 observations (63% completion rate).

Once the data were pared to 3,868 observations, they were examined to determine the multiple training pipelines that the students utilized to successfully complete DLIFLC. There were 56 distinct training pipelines used by these students. Table 3.1 describes each of these pipelines. Table 3.2 shows definitions for the codes in Table 3.1.

Table 3.1 Graduate Training Pipelines

		E1	E1	E2	E2	E3	E3	E4	E4	E5	E5	
TP	#	OC	Code	OC	Code	OC	Code	OC	Code	OC	Code	FP
P1	2959	Grad	*									**P1**
P2	32	D-Grad	*									**Drop**
P3	6	RC	A/Z	D-Grad	*							**Drop**
P4	319	RC	A	Grad	*							**P2**
P5	65	RC	Z	Grad	*							**P3**
P6	102	RC	J	Grad	*							**P4**
P7	7	RC	H	Grad	*							**P3**
P8	104	RL	A	Grad	*							**P5**
P9	15	RL	Z	Grad	*							**P6**
P10	11	RL	J	Grad	*							**P6**
P11	3	RL	V	Grad	*							**P6**
P12	5	RC	A	RC	A	Grad	*					**Drop**

		E1	E1	E2	E2	E3	E3	E4	E4	E5	E5	
TP	#	OC	Code	OC	Code	OC	Code	OC	Code	OC	Code	FP
P13	4	RC	Z	RC	Z	Grad	*					**Drop**
P14	3	RC	J	RC	J	Grad	*					**Drop**
P15	2	RC	A	RC	Z	Grad	*					**Drop**
P16	6	RC	A	RC	J	Grad	*					**Drop**
P17	3	RC	Z	RC	A	Grad	*					**Drop**
P18	2	RC	Z	RC	J	Grad	*					**Drop**
P19	1	RC	J	RC	A	Grad	*					**Drop**
P20	4	RC	A	RL	A	Grad	*					**Drop**
P21	1	RC	A	RL	Z	Grad	*					**Drop**
P22	1	RC	Z	RL	A	Grad	*					**Drop**
P23	1	RC	Z	RL	J	Grad	*					**Drop**
P24	2	RC	J	RL	J	Grad	*					**Drop**
P25	1	RC	J	RL	Z	Grad	*					**Drop**
P26	2	RL	A	RL	V	Grad	*					**Drop**
P27	1	RL	J	RL	V	Grad	*					**P6**
P28	3	RL	A	RC	A	Grad	*					**Drop**
P29	5	RL	A	RC	J	Grad	*					**Drop**
P30	2	RL	J	RC	A	Grad	*					**Drop**
P31	1	RC	A	RC	J	RL	J	Grad	*			**Drop**
P32	1	RC	J	RC	J	RL	J	Grad	*			**Drop**
P33	1	RC	A	RL	V	RL	Z	Grad	*			**Drop**

		E1	E1	E2	E2	E3	E3	E4	E4	E5	E5	
TP	#	OC	Code	OC	Code	OC	Code	OC	Code	OC	Code	FP
P34	1	RC	A	RL	A	RC	J	Grad	*			**Drop**
P35	1	RC	J	RL	J	RC	Z	RC	J	Grad	*	**Drop**
P36	9	Pass	41	Grad	*							**Drop**
P37	64	Fail	41	Grad	*							**P7**
P37A	65	Fail	41	Grad	*							**IE**
P38	18	RC	A	Fail	41	Grad	*					**P8**
P39	3	RC	Z	Fail	41	Grad	*					**Drop**
P40	6	RC	J	Fail	41	Grad	*					**Drop**
P41	2	RC	A	Pass	41	Grad	*					**Drop**
P42	1	RC	J	Pass	41	Grad	*					**Drop**
P43	3	Fail	41	Pass	41	Grad	*					**P7**
P44	1	Pass	41	Pass	RC	Z	Grad	*				**Drop**
P45	1	Fail	41	Pass	V							**Drop**
P46	1	RL	A	Pass	41	Grad	*					**Drop**
P47	8	RL	A	Fail	41	Grad	*					**Drop**
P48	1	RL	Z	Fail	41	Grad	*					**Drop**
P49	1	RL	J	Fail	41	Grad	*					**Drop**
P50	1	Fail	41	Pass	41	Grad	*					**Drop**
P51	1	Fail	41	Pass	V							**Drop**
P52	1	RC	A	Fail	41	Pass	41	Grad	*			**Drop**
P53	1	RC	A	Fail	41	Grad	*					**Drop**

		E1	E1	E2	E2	E3	E3	E4	E4	E5	E5	
TP	**#**	**OC**	**Code**	**OC**	**Code**	**OC**	**Code**	**OC**	**Code**	**OC**	**Code**	**FP**
P54	1	RC	A	Pass	41	Fail	41	Grad	*			**Drop**
P55	1	RL	A	RC	A	Fail	41	Grad	*			**Drop**
P56	1	RL	J	RC	J	Fail	41	Grad	*			**Drop**

Table 3.2 Explanation of Coding in Table 3.1

E 1/2/3/4/5	Number of Event for Each Student
TP	Original Training Pipeline
#	Number of Observations in Pipeline
OC	Outcome of Observation
Code	Reason for Outcome
FP	Final Training Pipeline Established
P#	Pipeline Number
Grad	Graduated from DLIFLC
D-Grad	Graduated from DLIFLC with Dual Languages
RC	Recycled into Same Language
RL	Relanguaged into New Language
Pass	Passed the DLPT
Fail	Failed the DLPT
A	Academic Trouble
H	Erroneous Enlistment

J	Medical
V	Personnel Action Pending
Z	Other – Not Defined
41	Post DLPT-Enhancement Training
*****	End of Input for Observation
IE	Input Error (Dropped from study)
Drop	Observations Dropped from Study

The majority of the pipelines identified had fewer than 10 observations in them. No noteworthy analysis could have been conducted on those numbers. In consultation with the Research and Analysis Division at the DLIFLC, these 56 pipelines were collapsed into 8 meaningful pipelines. Table 3.3 gives a description of these pipelines. These 8 pipelines contain 3,693 observations. This is 95% of the observations for this study. A total of 175 observations were dropped from consideration for this study due to the collapsing of pipelines.

Table 3.3 DLIFLC Training Pipelines

Pipeline	Total	Description
P1	2455	On-time completion.
P2	278	Recycled once due to academic difficulty.
P3	56	Recycled once due to other/undisclosed reason.
P4	94	Recycled once due to medical reasons.

Pipeline	Total	Description
P5	86	Relanguaged once due to academic difficulty.
P6	25	Relanguaged once due to other/undisclosed/medical.
P7	54	DLPT enhancement training required.
P8	17	Recycled once and DLPT enhancement training required.

The 3,693 observations in 8 established pipelines were sorted again based on number of years of service upon entering the DLIFLC. Those students who had more than two years of service (328 observations) were dropped from the study. This was to ensure that only first-term enlistees were considered for the present study. This resulted in 3,365 observations remaining for consideration.

2. DMDC Data

After the data provided by the DLIFLC had been sorted, the DMDC was requested to provide data from their databases for each of the 3,365 students. The data returned from the DMDC contained 3,253 observations. The DMDC did not have records for 112 students. Additionally, there were 188 students for whom critical data were missing and who subsequently had to be dropped from this study. The remaining 3,065 observations were then sorted by Total Active Federal Military Service (TAFMS), LOSS DATE and TERM (length of contractual obligation of enlistment) and Foreign Language Proficiency Pay (FLPP) to determine the post-DLIFLC success of each individual.

a. TAFMS, LOSS DATE and TERM

TAFMS is a variable that indicates the total military service that an individual has completed. It is reported in number of months. TERM refers to the enlistment obligation that a member has contractually agreed to. This number was reported in number of years. It was converted to months and then compared to TAFMS. LOSS DATE specifies the date that an individual left active military service. Individuals who had TAFMS less than TERM minus three months and had a LOSS DATE were considered to have attrited from the service. Those individuals that did not have a LOSS DATE were reviewed individually to determine their attrition status. The data revealed that 1,439 individuals did not complete their contractual obligation. An ATTRITION variable was created and set to "Yes" for these individuals. Of those who successfully completed DLIFLC training, 47% did not finish their first-term obligation.

b. FLPP

FLPP is a variable that was determined by reviewing when the last payment for foreign language proficiency was received for each individual. If a payment was received fewer than six months prior to the service member completing his or her obligated service, then FLPP was set "Yes." The six month-point was assumed to be the point at which most individuals would lose motivation for preparing for and/or taking the DLPT in order to keep receiving FLPP. Of the 3,065 observations, 234 did not

meet this requirement. This equates to 8% of those who successfully completed DLIFLC training.

c. Success

SUCCESS was a variable created from the ATTRITION and FLPP variables. SUCCESS will become the dependent variable for this study. If an individual did not attrit and received FLPP for the required amount of time, he or she was deemed successful and SUCCESS was flagged with a "Yes." There were 1,392 individuals that were considered a success. Out of 3,065 individuals, only 45% were successful once they left the DLIFLC.

B. VARIABLES

1. Dependent Variable

The dependent variable for this study was SUCCESS. The possible outcomes are successful and not successful. These outcomes are reflected in the variable SUCCESS as either "Yes" or "No." Table 3.4 summarizes the dependent variable.

Table 3.4 Dependent Variable Description

Name	Symbol	Classification	Description
Success	SUCCESS	Categorical	Yes, No

2. Independent Variables

The independent variables used are summarized in Table 3.5. The variables in this table are categorical and the final set used in the logistic regression (Chapter IV). They were determined by inspection of the data and by analyzing the results of the classification tree (Chapter IV). Variables that have been transformed from their original state are TERM.C, AFQT, DLAB and LANG. These transformations will be discussed in a later chapter.

Table 3.5 Independent Variable Descriptions

Name	Symbol	Classification	Description
Training Pipeline	TRAIN.PIPE	Categorical	P1,P2,P3,P4,P5, P6,P7,P8
Gender	SEX	Categorical	M (Male) F (Female)
Citizenship	CITIZ	Categorical	C (Citizen) N (Non-citizen) UK (Unknown)
Marital Status (at end of service)	MARRY	Categorical	S (Single) M (Married) UK (Unknown)
Ethnicity	RETH	Categorical	1 (White) 2 (Black) 3 (Hispanic) 5 (Asian) UK (Unknown)
Term of Initial Enlistment	TERM.C	Categorical	4, 5, 6

Name	Symbol	Classification	Description
Education Level (at entry into service)	EDUC	Categorical	1 (Less than HS) 2 (HS Diploma) 3 (HS Equivalency) 4 (Occupational Prgm) 5 (Attendance Cert OP) 6 (Attendance Cert HS) 7 (Correspond Cert) 8 (College-1 Semester) 9 (Alternate Training) 10 (Unknown)
Service	SVC	Categorical	N (Navy) M (Marine Corps) F (Air Force) A (Army)
Armed Forces Qualification Test Score	AFQT	Categorical	A (less than 75) B (75 - 90) C (91 -99)
Defense Language Aptitude Battery Score	DLAB	Categorical	A (90 and below) B (91-95) C (96-100) D (above 100)
Language	LANG	Categorical	I (Category I Lang) II (Category II Lang) III (Category III Lang) IV (Category IV Lang)
Native of English	NATIV.E	Categorical	Yes, No
Native of Other Language	NATIV.O	Categorical	Yes, No

Name	Symbol	Classification	Description
Motivation for Language Choice	MOTIV	Categorical	1 (Not my choice-do not want language training) 2 (Not my choice-not motivated for assigned language) 3 (Not my choice-motivated to study assigned language) 4 (Second or third choice) 5 (First choice)

C. DESCRIPTIVE STATISTICS

Tables 3.6 - 3.17 provide summaries of the descriptive statistics generated. Of particular interest are the success rates concerning the training pipelines, the individual services, gender and contract lengths and retention rates for each of the services. Noteworthy numbers are in bold.

Table 3.6 Observations

	Total	% of Total
Observations	3868	100%
Observations Not Used (Collapsing of Pipelines)	175	5%
Missing Record/Data (DMDC)	300	8%
Service > 2 Years	328	8%

	Total	% of Total
Observations Used	**3065**	**79%**

Table 3.7 Service Total

	Total	% Total
Observations	3065	100%
Army	1307	43%
Air Force	978	32%
Navy	409	13%
Marine Corps	371	12%

Table 3.8 Success

	Total	% of Total
Observations Used	3065	100%
Attrition	**1439**	**47%**
No FLPP	234	8%
Success	**1392**	**45%**

Table 3.9 Pipeline Total

	Total	% Total
Observations	3065	100%
P1	2455	80%

	Total	% Total
P2	278	9%
P3	56	2%
P4	94	3%
P5	86	3%
P6	25	1%
P7	54	2%
P8	17	.5%

Table 3.10 Service Success

	Total	Success	% Success
Army	1307	559	43%
Air Force	978	397	41%
Navy	**409**	**240**	**59%**
Marine Corps	**371**	**196**	**53%**

Table 3.11 Pipeline Success

	Total	Success	% Success
P1	2455	1123	46%
P2	278	127	46%
P3	56	20	36%
P4	94	38	40%
P5	**86**	**46**	**53%**

	Total	Success	% Success
P6	25	12	48%
P7	**54**	**19**	**35%**
P8	17	7	41%

Table 3.12 Gender Success

	Total	Success	% Success
Male	1894	912	48%
Female	**1171**	**480**	**41%**

Table 3.13 Service Success by Pipeline

	Total	Success	% Success
Army:			
P1	1011	427	42%
P2-P8	296	132	45%%
Air Force:			
P1	805	337	42%
P2-P8	173	60	34%
Navy:			
P1	**336**	**205**	**61%**
P2-P8	73	35	48%
Marine Corps:			
P1	**303**	**154**	**51%**
P2-P8	68	42	62%

Table 3.14 AFQT Success

AFQT Score	Success	Failure	% Success
Less than 75	**428**	**295**	**59%**
75-90	433	642	40%
91-99	531	736	42%

Table 3.15 Language Category Success Rates

Language Category	Success	Failure	% Success
I	259	300	46%
II	2	1	67%
III	476	532	47%
IV	655	840	44%

Table 3.16 Enlistment Contract Length by Service

	4 Yrs or Less	%4 Yrs or Less	5 Yrs	%5 Yrs	6 Yrs	%6 Yrs
Army	293	22%	913	**70%**	101	8%
Air Force	301	31%	72	7%	605	**62%**
Navy	327	**80%**	35	9%	47	11%
Marine Corps	74	20%	292	**79%**	5	1%

Table 3.17 Success Rates by Service by Length of Contract

Contract Length	Army		Air Force		Navy		Marine Corps	
	S	**F**	**S**	**F**	**S**	**F**	**S**	**F**
4 Yrs or Less	170	123	200	101	198	129	59	15
%Success	**58%**		**66%**		**61%**		**80%**	
5 Year	375	538	63	9	25	10	135	157
% Success	**41%**		88%		71%		**46%**	
6 Years	14	87	134	471	17	30	2	3
% Success	**14%**		**22%**		**36%**		**40%**	

Table 3.18 Service Retention Rates

	Total	**Retained**	**% Retained**
Army	1307	414	32%
Air Force	978	273	28%
Navy	**409**	**235**	**57%**
Marine Corps	371	87	23%

1. Training Pipelines

This study set out to determine whether there were significant differences in the success rates of individuals in each training pipeline. The first and most interesting statistic generated concerned training pipeline P1. Training pipeline P1 was considered the base pipeline. This pipeline consisted of those individuals who successfully completed their course work and passed the

DLPT as originally assigned (on time). There were 2,455 individuals who in pipeline P1. Only 1,123, or 46%, were subsequently successful. Though there were no statistically significant differences (0.05 level) when comparing P1's success rate to those of the other pipelines, because of the low number of observations in the other pipelines, it is difficult to assert any significance to this finding. Table 3.19 gives the *z*-statistic from the two-sample test of proportions and the associated p-values for the different pipelines. It is interesting to note that the success rate for pipeline P2 (recycle once due to academic trouble) is essentially the same as P1 (46%), but the success rate for pipeline P5 (relanguage once due to academic trouble) is noticeably higher (53%). Though there was no statistically significant difference ($p = 0.20$) there still appears to be a large enough spread between the success rates to believe that a difference may actually exist. This assertion is made due to the weakness in the statistical test used caused by the low number of observations in the pipeline. A possible explanation is that those individuals that relanguage once are more motivated (satisfied) with their new language (presuming no academic difficulty in the second language) and this indicates that they may have been more satisfied with their career after leaving the DLIFLC. Those individuals who recycled once into the same language in which they had academic difficulty may not have been as satisfied in their career due to this difficulty.

Table 3.19 Training Pipeline Statistical Inference

	% Success	z-statistic	p-value
P1	46%		
P2	46%	0	0.9602
P3	36%	1.49	0.1362
P4	40%	1.15	0.2502
P5	53%	1.28	0.2006
P7	35%	1.61	0.1070

Due to the low number of observations for P6 and P8, no inferential test was conducted.

2. Service Breakdown

There is a statistically significant difference among the services in regard to success rates. The success rate for the Navy (59%) is considerably higher than the other services. The Marine Corps (53%) has an appreciably higher rate than the Air Force (40%) and Army (42%). The Air Force has the lowest success rate. Using the Navy as the baseline, the different success rates are statistically significant for the Army and Air Force at the 0.05 level and for the Marine Corps at the 0.10 level. This suggests that service affiliation may be associated with success. Table 3.20 gives the *z*-statistic and p-values for the success rates. These statistics are especially significant for the Army and the Air Force. These two services account for 75% of all observations.

Table 3.20 Service Success Rates

	% Success	*z*-statistic	p-value
Navy	59%		
Army	43%	5.66	0.00*
Air Force	41%	6.13	0.00*
Marine Corps	53%	1.69	0.09**

**Significant at all levels. **Significant at the 0.10 level.*

3. Contract Lengths and Service Success Rates

When analyzing success rates by contract length, it is immediately apparent that those individuals with contract lengths of five and six years have a considerably lower success rate (37%) than those with contract lengths of four years or less (63%). Dissecting this data further reveals that the majority of Navy contracts are four years or less, Marine Corps contracts are five years, Air Force contracts are six years and Army contracts are five years. The non-Navy groups account for some of the lowest success rates for each of the services (Marine Corps 46%, Army 41%, Air Force 22%). All services have success rates above 50% for individuals with contracts of four years or less and all services have success rates equal to or below 40% for individuals with six-year contracts. The highest success rate was for the Air Force (88%) for five-year contracts. It appears that contract lengths are associated with success rates and that there might be some interaction between service and contract length. Figure 3.1 graphically displays the success rates by service by contract length.

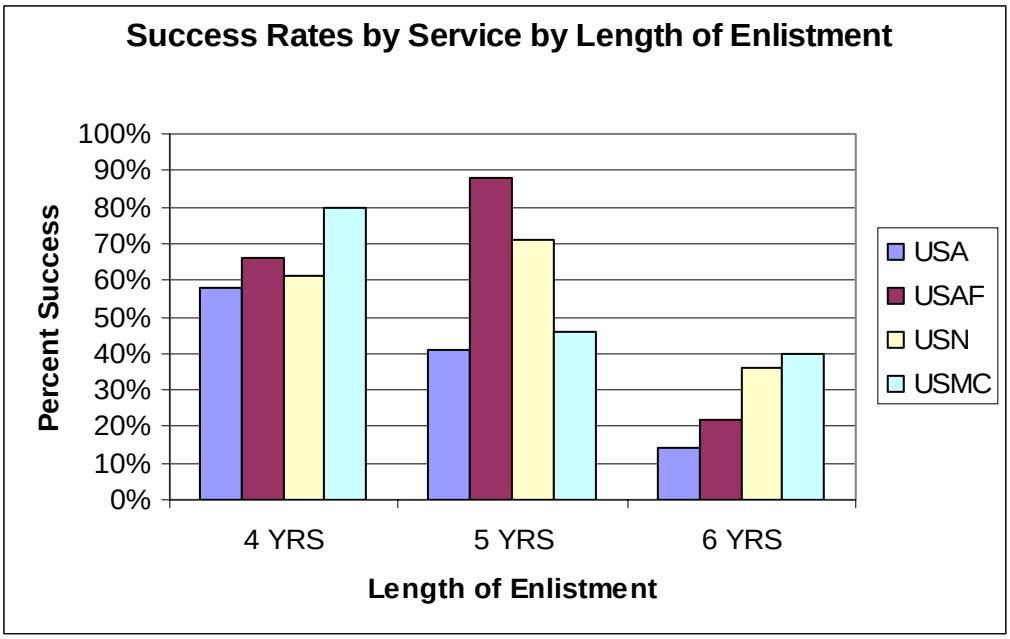

Figure 3.1 Success Rates by Service by Enlistment Length

4. Gender

There were 1,894 males within this study. Out of those 1,894, only 912 or 48% were successful once they left DLIFLC. There were 1,171 females within the study; only 480 or 41% of those were subsequently successful after DLIFLC. This difference of 7% suggests that gender may be associated with success. Table 3.20 gives the *z*-statistic and p-value for success rates using males as the baseline.

Table 3.21 Gender Success Rates

	% Success	*z*-statistic	p-value
Male	48%		
Female	41%	3.78	0.00*

*Significant at all levels.

5. AFQT

AFQT scores reveal an intriguing finding. Contrary to what other studies have found, this study has found that lower AFQT scores are related to success. Those individuals with AFQT scores below 75 had the highest success rates (59% versus 40% for scores between 75-90 and 42% for scores between 91-99). The differences in success rates are statistically significant. Table 3.21 gives the *z*-statistic and p-value for the success rates. Looking more closely at the data reveals that the AFQT scores below 75 range from 0-74. Over half the scores in this range are 0. A 0 indicates that the AFQT score is missing for this observation. Because of this finding it is difficult to attribute any meaning to the previous findings.

Table 3.22 AFQT Success Rates

	% Success	***z*-statistic**	**p-value**
Less than 75	59%		
75-90	40%	8.12	0.00*
91-99	42%	7.33	0.00*

** Significant at all levels.*

6. Retention

Though retention rates are not the emphasis of this study, the statistics are easily derived and important for all services. The statistics are critical because the more people who remain in service past their obligated service, the less money has to be spent on recruiting and training

people to replace them. The Marine Corps (24%), Air Force (28%) and Army (31%) all had retention rates noticeably lower than that of the Navy (58%). By inspection, it can be determined that these retention rates are considerably different. Of particular importance in this discussion is the fact that the majority of enlistment contracts for the Navy were four years, yet the Navy is still getting five or more years of service on average out of these individuals.

D. SUMMARY

Though the success rates for the different pipelines were not found to be statistically significant the pipelines may still have some effect on success. Low numbers of observations in most pipelines do not make the inferential statistics very meaningful. Service affiliation, gender, AFQT and contract length all appear to have an effect on success rates. Previous studies have shown these factors to have effects on service attrition, although this study shows the relationship of AFQT scores and success to be opposite of what previous studies indicate. The following chapter will describe the analysis of these and other factors and the conclusions drawn from them.

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IV. METHODOLOGY, ANALYSIS AND RESULTS

The results for the classification tree and logistic regression analyses for post-DLIFLC success are contained in this chapter. The methodology and evaluation of results are described in the following sections.

A. CLASSIFICATION TREE

1. Methodology

A classification tree is a statistical method used to predict the state to which an observation is most likely to belong. The method is termed a “tree” because the graph appears as an upside-down tree. The first node in the tree is the “root node.” It is split into two nodes which are then split into three or four nodes. Each node is an independent variable being split. This process continues until predetermined limits of splitting are achieved. The general procedure for classification trees is at every opportunity to split, the split that maximizes the node purity is used. This is accomplished through the algorithm searching through all independent variables and evaluating all possible splits and determining the split that would minimize the deviance (twice the log-likelihood) of that node. (Montgomery, et al., 2001) A large data set, with many predictor variables, would develop into a very complex tree. Although this is the tree with the maximized node purities, it is not the optimal design. The optimal tree is determined through cross-validation and pruning.

Cross-validation is a method that optimizes both the purity of the tree and its ability to accurately classify new data. One method of cross-validation is to partition the data into ten nearly equal size sets. Each set is withheld in turn and the remaining nine sets are used to grow a tree. A tree is grown to its maximum size and then pruned back to the root node. The tree is pruned in a manner that tries to maximize the purity at the new number of splits. The minimum deviance of each size tree for the ten trials is found. Next, an evaluation of the penalized deviance, a weighted sum of the minimum deviance and the number of leaves in the tree, is conducted. There is a point in growing trees where the size of a tree is so large that it loses its predictive power and the penalized deviance begins to increase. Cross-validation plots give an idea as to the optimal size of a tree to minimize the penalized deviance and to allow for proper pruning. Pruning limits the size of the tree. The optimal size for the tree determined from cross-validation is used to grow the new tree.

The S-Plus 6.2 (statistical software package) functions for building, cross-validating and pruning trees were used to build a classification tree for this study. A classification tree was used for this study to help in determining the structure of the data. Some of the independent variables had many levels and two independent variables were continuous, DLAB and AFQT. The classification tree helped in collapsing the number of levels in some categorical variables and in establishing levels for transforming the continuous variables into categorical ones. Additionally, the classification tree

helped in determining whether there were differences in the training pipelines since statistically they were determined not to be significantly different.

All 3,065 observations were used in the building of the classification tree. All independent variables were used in the initial process of building the tree. After initial analysis, cross-validation and pruning, the final classification tree was determined. The following section of this chapter contains the results of the tree.

2. Analysis and Results

The first classification tree built used the RETH variable for the first split. The split was based on the level “Unknown” and all others. RETH was not split again in the cross-validated and pruned tree. It was determined not to use RETH as a variable in building the tree or the logistic regression. Splitting only on the level “Unknown” contained no useful information about the data. All other variables (Table 3.5) were retained for consideration in the classification tree.

The classification tree was allowed to grow to its full size; then, cross-validation and pruning were used to find the optimal size. Figure 4.1 shows the cross-validation plot for the data. It was determined through evaluation of this plot that the optimally-sized tree contained approximately 15 leaves. The pruned tree for this data is presented in Figure 4.2. The tree shows that the variables CITIZ, TERM.5, SVC, AFQT, LANG, EDUC, TRAIN.PIPE, MOTIV and DLAB were used to grow this tree. The misclassification rate for this tree was determined by

counting the misclassified observations in each terminal node and dividing by the total number of observations. The misclassified observations are represented by the numbers underneath each leaf of the tree and to the left of the slash mark. The misclassification rate for this tree was 31% which is better than the 45% misclassification rate of the root node.

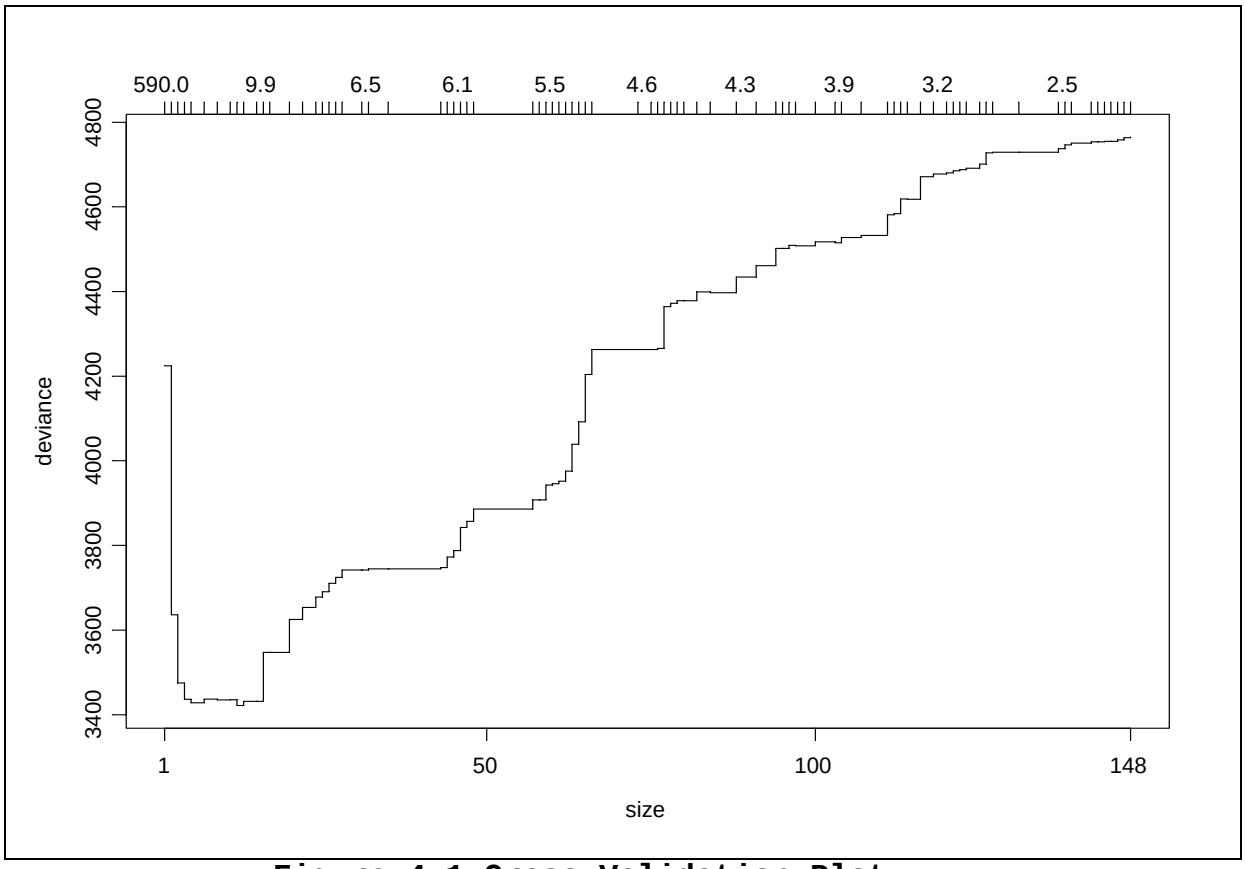

Figure 4.1 Cross-Validation Plot

The tree identified citizenship early as an important factor for success. The split was on “Citizen”-“Non-Citizen” and unknown. This does not provide useful information, but was left in the model due to the fact that

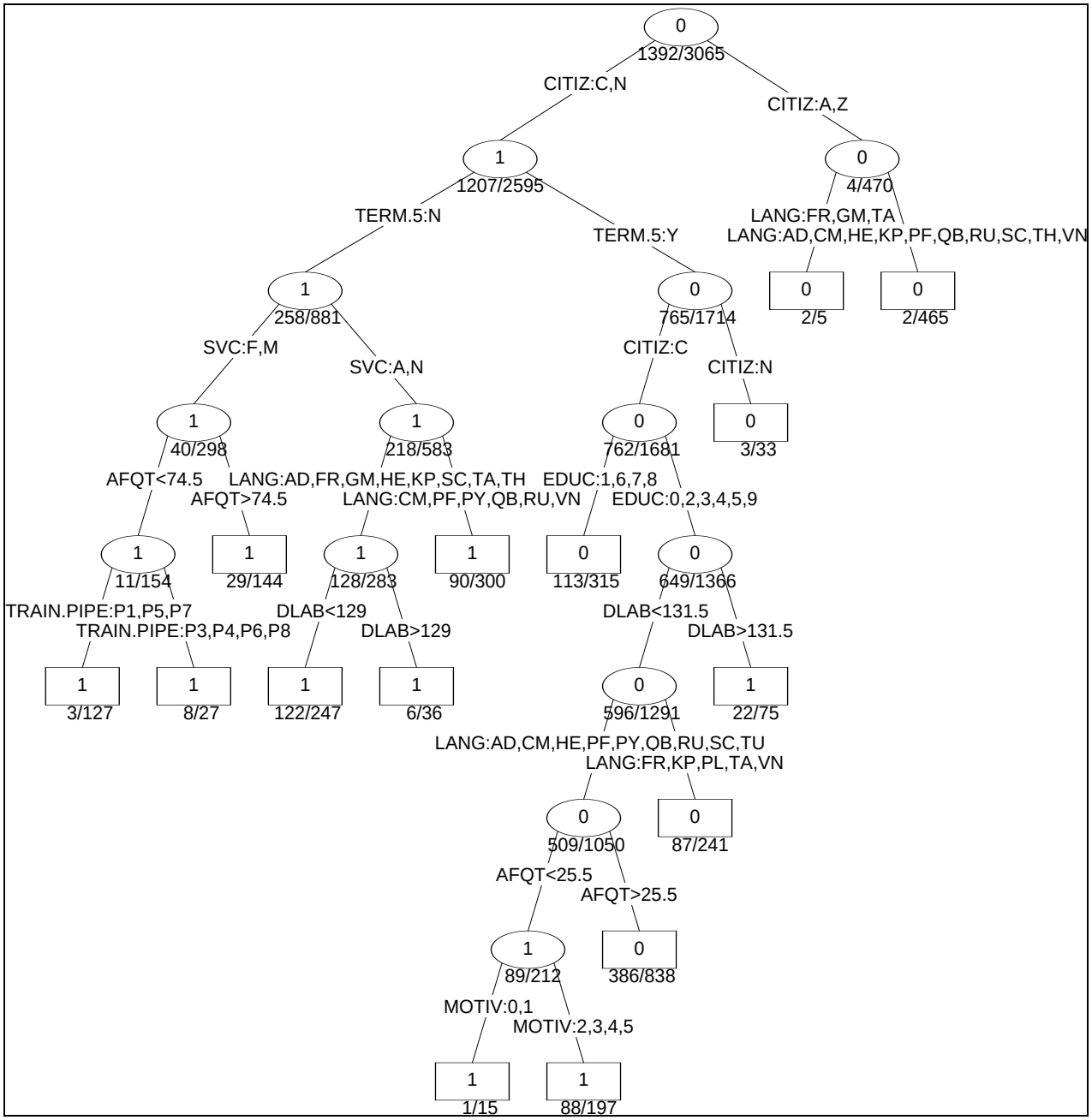

Figure 4.2 Classification Tree

The ovals represent non-terminal nodes; the rectangles represent terminal nodes. The number in each oval and rectangle represent the classification of the observations in that node (1=Success, 0=Failure). The numbers below the nodes are the number misclassified and the total number of observations in the node.

“Citizen” and “Non-Citizen” were split two levels below. 1,714 observations were split at this level; therefore this variable was deemed to be important to the model and left in.

Other factors that were deemed important in the model included: TERM.5, AFQT, LANG and TRAIN.PIPE. Though other variables were deemed important, these are of special interest. TERM.5 was identified after the variable CITIZ as being significant to the model. For this split, those enlistees who had a contract of four years or less had a success rate of 71% compared to a 45% success rate for those with service contracts greater than four years. This confirms what the descriptive statistics suggested in earlier chapters; that contract length is a central factor in success rates for enlistees. After additional evaluation of contract lengths, it was determined that a variable for contract lengths with three levels (four-year contracts, five-year contracts and six-year contracts) will be used for contract length (TERM.C). Individuals with contract lengths of two and three years were grouped with those who had four-year contracts. This was done because there were only 45 observations with two-year or three-year contracts. The variable TERM.C provided the best descriptive statistics (Chapter III) and logistic regression model (next section). Additionally, the only noteworthy split for AFQT occurred at 74.5. This led to using 75 to create levels within the AFQT variable, making it categorical. The variable LANG did not appear to split in any interpretable manner. When proceeding to the logistic regression, the variable was collapsed into four levels based on the category of difficulty determined by

the DLIFLC. Finally, TRAIN.PIPE was identified as important only in the last level of splits. This is worth mentioning, because it suggests that TRAIN.PIPE may not be useful during a logistic regression. Overall the model provides a good first look at the factors that affect post-DLIFLC success.

B. LOGISTIC REGRESSION

1. Methodology

Regression is a technique used to estimate the relationship between a set of independent variables called predictors to a dependent variable called a response variable. Logistic regression is the technique applied to binary response variables to find the probability that an observation falls into one of the two categories of the response variable. It uses the method of maximum likelihood to produce estimates of the coefficients for each independent variable in order to produce a prediction. (Hosmer and Lemeshow, 1989) By establishing a threshold for the predicted value, the predicted value can be classified into one of two response categories. The usual threshold is 0.50. By comparing the observation with the predicted value, the model can be evaluated for its usefulness.

This study looks at the binary variable “SUCCESS” as the response variable and independent variables that are all categorical with varying numbers of levels. One level of the independent variable was chosen as the default level; *k* levels were then replaced with *k-1* variables. The

default levels for each independent variable are listed in table 4.1. The S-Plus 6.2 logistic regression function was used to fit a model using all main effects of the independent variables. The model was limited to main effects because of the computational complexity of adding second order and above interactions. After building the model with all independent variables, analysis of deviance

Table 4.1 Default Independent Variable Levels

TRAIN.PIPE	Pipeline 1
SEX	Female
CITIZ	Citizen
TERM	4-Year Contract
SVC	Army
AFQT	Less than 75

was used to determine which variables were significant in predicting the response variable. (Hosmer and Lemeshow, 1989) Using the *dropterm()* function from the S-Plus MASS library, each independent variable was evaluated based on its significance to the model. If a variable was determined to be not significant it was dropped from the model and the model was fit again without that variable. The difference in deviance between the model with and the model without the variable was compared to a chi-square distribution. If this statistic was not significant, the new model was kept. This process was repeated until no

more variables could be deleted from the model. This process produced a final model.

After the final model had been generated, it was evaluated for its "goodness-of-fit." "Goodness-of-fit" was analyzed through analysis of deviance and the Hosmer-Lemeshow test. (Hosmer and Lemeshow, 1989) A "rule of thumb" was used for analysis of deviance to get an idea of the model before proceeding to the Hosmer-Lemeshow test. This suggested that if the residual deviance is approximately equal to $n-p$ degrees of freedom the model is adequate in predicting the response variable. After determining the model was adequate, the Hosmer-Lemeshow test was conducted. This test sorts the predictions into g groups based on percentiles of estimated probability. In each group the number of good responses and the sum of the predicted probabilities are computed. A table of observed and expected frequencies is developed from the previous computations. Next a "C" statistic is calculated using the Pearson chi-square statistic from the table of observed and estimated expected frequencies. This statistic is approximated to the chi-square distribution with $g-2$ degrees of freedom, where g was taken to be 10. If the p-value computed from the chi-square distribution is not significant, the model is deemed to fit well. (Hosmer and Lemeshow, 1989)

After evaluating the "goodness-of-fit" and determining the final model composition, interpretation of the results took place. Part of this interpretation involved calculating the odds ratios and confidence intervals for each independent variable.

2. Analysis and Results

The logistic regression model for the DLIFLC data involved analyzing all 3,065 observations and independent variables. Using analysis of deviance and the *dropterm()* function in S-Plus, the model was pared down to just 6 independent variables (with multiple levels). The final model's "goodness-of-fit" was evaluated using the Hosmer-Lemeshow test to ensure model adequacy. Table 4.2 displays the results for this model. This table includes the variables, estimated coefficients, standard errors, t-values, odds ratios and confidence intervals for each of the odds ratios in the final model. Variables of significance (confidence intervals that do not contain 1) are highlighted.

The variables TRAIN.PIPE (2,3,4,5,6,8) did not appear to be different than TRAIN.PIPE (1) and Navy did not appear to be different than the Army. Of interest in this model were the variables TRAIN.PIPE (7), SEX, SVC (Air Force and Marine Corps) and AFQT. Evaluating each of these variables individually while holding all others constant provides valuable insight into how these variables affect success. TRAIN.PIPE (7) was the only pipeline that was marginally significant in this model. The model suggests that individuals that successfully complete the DLIFLC through TRAIN.PIPE (7) have 0.28-0.99 the odds of success as those who complete through TRAIN.PIPE (1). This is important because TRAIN.PIPE (7) is the pipeline that contains individuals that required post-DLPT enhancement training. Within the SEX variable males were shown to have a higher

Table 4.2 Logistic Regression Model for Post-DLIFLC Success

Coefficients	Estimate	Error	t-value	Odds Ratios	CI Lower	CI Higher
Intercept	0.84	0.17	5.08			
Pipeline 2	-0.16	0.14	-1.11	0.85	0.65	1.12
Pipeline 3	-0.24	0.32	-0.77	0.79	0.42	1.47
Pipeline 4	0.19	0.27	0.70	1.21	0.71	2.05
Pipeline 5	0.27	0.25	1.09	1.31	0.80	2.14
Pipeline 6	0.21	0.52	0.41	1.23	0.45	3.42
Pipeline 7	**-0.64**	**0.32**	**-1.99**	**0.53**	**0.28**	**0.99**
Pipeline 8	-0.14	0.54	-0.25	0.87	0.31	2.51
Male	**0.32**	**0.09**	**3.54**	**1.38**	**1.15**	**1.64**
Non-Citizen	**-0.93**	**0.30**	**.3.12**	**0.39**	**0.22**	**0.71**
Unknown-Citizen	**-5.14**	**0.51**	**-10.18**	**0.01**	**0.00**	**0.02**
5-Year Term	**-0.82**	**0.12**	**-7.15**	**0.44**	**0.35**	**0.56**
6-Year Term	**-2.27**	**0.16**	**-14.34**	**0.10**	**0.08**	**0.14**
Air Force	**1.06**	**0.17**	**6.28**	**2.89**	**2.07**	**4.03**
Marine Corps	**0.08**	**0.12**	**0.67**	**0.86**	**1.08**	**1.37**
Navy	-0.01	0.15	-0.06	0.99	0.74	1.33
AFQT (75-90)	**-0.41**	**0.13**	**-3.13**	**0.66**	**0.51**	**0.86**
AFQT (91-99)	**-0.40**	**0.13**	**-3.03**	**0.67**	**0.52**	**0.86**

probability of success. The confidence interval for males suggests that males have a 1.15–1.64 times greater

predicted odds of success. This corresponds to the inferential statistics presented in Table 3.20. The AFQT variable was interesting in that in this model it was shown that individuals with an AFQT score below 75 had a higher probability of success than those above 75. For individuals with AFQT scores between 75–90, their predicted odds of success was 0.51–0.86 of those below 75. For individuals with AFQT scores between 90–99, their predicted odds of success was 0.52–0.86 of those below 75. After looking more closely at the AFQT variable (Chapter III), no meaning can be drawn from the analysis concerning AFQT. Over half the observations with AFQT scores below 75 were 0. A 0 would indicate that the AFQT score for that individual was missing. The variable was left in the model because the model was determined to have better "goodness-of-fit" with the variable than without it. Finally, the SVC variable provides valuable information. It was found that individuals in the Air Force had 2.07–4.03 times the predicted odds of success and the Marine Corps had a 1.08-1.37 times the predicted odds of success compared to the Army. The model does not suggest any difference for the Navy (confidence intervals that contain 1). At first glance this information seems to be in opposition to the statistics developed in Chapter III. Table 3.19 suggests that the Navy has a significantly higher percentage of success. Tables 3.15 and 3.16 reveal that the Navy has the highest percentage of contracts for four years and the Air Force has the highest percentage of contracts that are for six years. The Navy, Air Force and Marine Corps all have high success rates for four-year contracts and all services have low success rates for six-year contracts. The Air

Force has a higher percentage of success for four-year (66%) and five-year (88%) contracts compared to the Navy (61% and 71% respectively). The Marine Corps has a higher percentage of success for both four-year (80%) and six-year (40%) contracts compared to the Navy (61% and 36% respectively). The Marine Corps also has the highest percentage of success for six-year contracts. The Navy's success rates are lower in two out of three categories of contracts compared to the Air Force and Marine Corps. With this information, the model makes intuitive sense. Overall the model begins to determine what factors are influential in determining post-DLIFLC success. Combined with the classification tree model it provides a good look at these relationships.

C. SUMMARY

This chapter presented the models developed to try to predict success for an individual after graduating from the DLIFLC. Classification trees and logistic regression were used.

The classification tree that was used provided a base to begin the logistic regression. In particular it provided a threshold for AFQT scores in order to develop levels within the variable. It also revealed that TRAIN.PIPE, the primary variable of concern at the beginning of this study, was only slightly influential. This was reflected in the inferential statistics developed and was again reinforced with the logistic regression. Overall, the classification tree provided a good reference

for those variables that are influential in predicting success.

The last step in the analysis of the data collected was in developing and analyzing a logistic regression. After successfully paring down the variables using analysis of deviance and ensuring “goodness-of-fit” using the Hosmer-Lemeshow test, a final model was established. This model showed that the variables TRAIN.PIPE (7), SEX, AFQT and SVC (Air Force and Marine Corps) were important in predicting success after successful completion of DLIFLC. Though no conclusions can be drawn concerning AFQT, it was left in the model because the model was determined to have better “goodness-of-fit” with the variable than without it. SVC was particularly interesting in that it revealed information that was not known or was not apparent at the beginning of this study. Though the Navy had higher percentages of success, the Air Force and Marine Corps were better predictors of success within SVC. The model developed provided valuable and useful information and can be used in the future to jumpstart further research.

V. SUMMARY, CONLCUSIONS AND RECOMMENDATIONS

A. SUMMARY AND CONLUSIONS

This study attempted to analyze various personnel, military and academic attributes of students who had graduated from the DLIFLC, in order to determine the effects these factors had on success after DLIFLC. Chapter I opened with an introduction of this study and background information on the DLIFLC and the students who are enrolled at the institute. Chapter II described various other studies that identified variables shown to have an effect on successful completion of DLIFLC training and on first-term enlisted attrition. These variables were used as guides and starting points for this study. Chapter III gave a description of the data used for this study along with the development of numerous descriptive and inferential statistics. Chapter IV included the classification tree and logistic regression model's analysis and results developed for this study.

Data were gathered on first-term enlistees in the Army, Air Force, Marine Corps and Navy who entered the DLIFLC between fiscal years 1997–2000 and who graduated. The DLIFLC and DMDC provided information pertaining to the students' personnel, military and academic backgrounds. Out of 56 training pipelines enumerated in the data gathered from the DLIFLC, 8 were used. The remaining pipelines did not contain enough cases to make any analysis meaningful. After sorting through all the data from the DLIFLC and DMDC, a total of 3,065 observations were considered for use in this study.

To have been considered a graduate of the DLIFLC, a student had to successfully complete his or her course of study and meet the requirement of a 2/2/1+ in listening, reading and speaking on the DLPT. Post-DLIFLC success was defined as an individual completing his or her contractual obligation and maintaining his or her language proficiency during their initial tour of duty. A threshold of up to three months prior to the end of contractual obligation was used for completion of service due to the fact that services often allow service members to leave the service prior to the end of their contract. It is acknowledged that three months may or may not be the best threshold; however, nothing in the data suggested that it was not adequate. Maintaining language proficiency was measured by continuation of FLPP up to six months prior to end of service. This threshold was established due to the assumption that the amount of FLPP would not be adequate in convincing an individual to put the time and effort into obtaining the minimum requirements on the DLPT for the remaining six months. FLPP was considered adequate in encouraging language proficiency prior to that threshold. Again, this threshold may or may not be the best choice, but was deemed adequate by all parties involved in this study. After defining success at the DLIFLC and post-DLIFLC success, the data revealed that only 63% of first-term enlistees who entered the basic program at the DLIFLC between 1997-2000 graduated. More surprising is the fact that, of those individuals that graduated from the DLIFLC, only 45% were subsequently successful. 47% of those who graduated from the DLIFLC attrited before completing their term of enlistment. The remaining 8% did not maintain

their language proficiency. 47% attrition is troublesome considering the amount of time and money that has been invested in each of these individuals by their services.

Chapter III discussed the descriptive statistics that were developed during this study. The statistics describing service success rates, contract lengths and success rates by contract length and service are all particularly important. Just looking at service success rates, the Navy (59%) has the highest success rates followed by the Marine Corps (53%), the Army (43%) and the Air Force (41%). This would suggest that service affiliation has an effect on success. Looking further into the data revealed that the Navy had the highest percentage of four year or less contracts, the Army had the highest percentage of five-year contracts and the Air Force had the highest percentage of six-year contracts. All services had success rates above 50% for four or fewer years and all services had success rates equal to or below 40% for six-year contracts. In two out of three contract length categories the Air Force has a higher percentage of success than the Army or Navy. The Marine Corps has a higher percentage in all three contract categories than the Army and in two out of three than the Navy. This is important in that it shows overall service success rates can be misleading because the proportion of contract lengths among each of the services vary. Looking at contract length categories by service gives a better idea how the services compared and it shows how important contract lengths are to success.

After developing descriptive statistics, a model using classification trees was developed using S-Plus 6.2 software. This model was interesting in that it provided a

threshold for AFQT scores in order to develop levels within the variable to transform it from numeric to categorical. It also identified CITIZ, TERM.5, SEX, SVC, AFQT, LANG, DLAB, EDUC, MOTIV and TRAIN.PIPE as influential in predicting success. However, TRAIN.PIPE was identified as only slightly significant as determined by how far down the tree it appeared and that it was used in only one split. Due to no discernible thresholds breaking out within the LANG and DLAB variables, the levels were established consistent with the DLIFLC requirements and classifications. The DLAB minimum proficiency cut-offs were used to determine levels within the DLAB variable. The DLIFLC classification of languages (I, II, III, IV) were used as levels within the LANG variable. The results of the classification tree helped in understanding the data and in beginning to develop a logistic regression model. The results were also important in that both the classification tree and logistic regression model found common variables as influential.

Using the threshold established for AFQT, LANG and DLAB and the new contract length variable TERM.C, a logistic regression model was developed. This model was evaluated by way of analysis of deviance and its “goodness-of-fit” by way of the Hosmer-Lemeshow test. The final model used TRAIN.PIPE, SEX, CITIZ, TERM.C, SVC, and AFQT. Except for TERM.C, these variables appear in the classification tree as well. TERM.5 (a collapsed version of TERM.C) was used in the classification tree. The variable LANG did not appear in the final model. Language difficulty did not appear to have an effect on post-DLIFLC success.

This model showed that each of the variables retained had one or more levels that were significant in predicting the odds of success. Individuals that graduated from the DLIFLC through training pipeline 7 were less likely to be successful than those who graduated through training pipeline 1. Males were more likely to be successful; U.S. citizens were also more likely to be successful. Overall, individuals with five-year or six-year contracts were significantly less likely to succeed than those with contracts of four years or fewer years. The Air Force and Marine Corps were both more likely to succeed than the Army. Though AFQT scores were shown to be significant, no conclusions can be drawn from the analysis because of the fact that over half the observations below 75 were missing an AFQT score. This model, in concert with the classification tree, provides a good preliminary first look at these data and what they can reveal about post-DLIFLC success. This model and study should be expanded upon to try and ascertain more meaning to the results and to ensure the results remain consistent for other groups of DLIFLC graduates.

B. RECOMMENDATIONS

This study was the first to try and capture an individual's probability of success after successfully completing DLIFLC training. The analysis and results have provided a good glimpse into what characteristics begin to help in explaining an individual's post-DLIFLC success. Now that this study has been completed, follow-on research can use it as a starting point to more fully explore the characteristics established here and in developing ideas

for other characteristic that were missed. One recommendation is to include more in-depth analysis of the characteristics established as influential in this study especially the influence of gender, service affiliation, contract lengths and AFQT scores. In particular, interactions among the independent variables should be considered. Additionally, job assignment after the DLIFLC training should be reviewed to determine its importance in predicting success. Also, it is recommended that economic factors that could influence an individual's success in the military (unemployment rate, civilian career opportunities for language skills, etc) should be reviewed. Finally, research should be completed on FLPP to try to discover whether the levels of compensation have influence on an individual's success post-DLIFLC.

APPENDIX A. NON-GRADUATE TRAINING PIPELINES

Table A.1 gives a brief description of the basic pipelines traversed by these individuals. Out of 6162 observations, 2294 did not graduate for academic, administrative and various other reasons. This equates to 37% of those that started DLI. Table A.2 describes the codes used in Table A.1.

Table A.1 Non-Graduate Training Pipelines

TP	#	OC	Code	OC	Code	OC	Code	OC	Code
F1	1107	NG	A						
F2	283	NG		NG	A				
F3	30	NG		NG	A				
F4	620	G		DLPT	A				
F5	230	NG		G		DLPT	A		
F6	23	NG		G		DLPT	A		
F7	1	NG		NG		G		DLPT	A

Table A.2 Explanation of Failure Pipeline Coding

TP	Training Pipeline
#	Number in Training Pipeline
OC	Outcome for Observation

Code	Reason for Outcome
F#	Failure Pipeline
NG	Did Not Complete Coursework
G	Completed Coursework
DLPT	Failed DLPT
A	Attrited from DLPT

Due to the fact that this study was focused on only those that graduated DLIFLC, reasons for each outcome was not tracked. This information can be easily obtained from DLIFLC data.

LIST OF REFERENCES

Anderson, R.E., "Study of Initial Entry Student Attrition From Defense Language Institute Foreign Language Center," Master's Thesis, Naval Post Graduate School, Monterey, California, September 1997.

Buddin, R., "Analysis of Early Military Attrition Behavior," RAND Research Brief, 1984, http://www.rand.org/publications/RB/RB2001/, [25 August 2005].

Buttrey, S. E. and Larson, H.J., "Determining Characteristic Groups to Predict Army Attrition," Naval Post Graduate School, Monterey, California, 1999.

Cook and Quester, "What Characterizes Successful Enslistees in the All-Volunteer Force: A Study of Male Recruits in the Navy," *Social Science Quarterly*, 1992.

Defense Foreign Language Institute Foreign Language Center, http://www.dliflc.edu/about%20DLIFLC/about_dliflc_index.html, [25 August 2005].

Devore, J.L., "Probability and Statistics: For Engineering and the Sciences," Thompson Brooks/Cole, 2004.

Hosmer, D.W. and Lemeshow, S., "Applied Logistic Regression," A Wiley-Interscience Publication, 1989.

Interagency Language Roundtable, "Welcome To The Interagency Language Roundtable," http://www.govtilr.org/, [25 August 2005].

Jackson, G.L. and Shaw, V.M.W., Language Choice and Performance, Defense Language Institute Foreign Language Center, 1994.

Keesling, W. J., Language Skills Change Project, Relook: Final Report, Defense Language Institute Foreign Language Center, 1997.

Menard, S. "Applied Logistic Regression Analysis," Sage Publications, 2002.

Montgomery, D.C., Peck, E.A. and Vining, G.G., "Introduction to Linear Regression Anlysis," A Wiley-Interscience Publication, 2001.

O'Mara, F.E., Lett, J.A. and Alexander, E.E., LSCP Report II, The Prediction of Language Learning Success at DLIFLC, Defense Language Institute Foreign Language Center, 1994.

O'Mara, F.E, LSCP Report III, Training Approaches for Reducing Student Attrition from Foreign Language Training, Defense Language Institute Foreign Language Center, 1994.

S-PLUS 6.2 Users' Guide, Insightful Corporation, Seattle, Washington.

Whelan, B.E., Workshop on Language Student Attrition, United States Army Research Institute for the Behavioral and Social Sciences, 2001.

Wong, C.H., "An Analysis of Factors Predicting Graduation of Students at Defense Language Institute Foreign Language Center," Master's Thesis, Naval Post Graduate School, Monterey, California, December 2004.

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